इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 8570 (1977): Presspaper for Electrical Purposes [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 8570 - 1977
(Reaffirmed 2001)

Indian Standard

SPECIFICATION FOR PRESSPAPER FOR ELECTRICAL PURPOSES

(Second Reprint DECEMBER 1993)

UDC 621.315.614.6:676.254

© *Copyright* 1977

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6 *December* 1977

Indian Standard

SPECIFICATION FOR PRESSPAPER FOR ELECTRICAL PURPOSES

Electrical Insulations Sectional Committee, ETDC 18

Chairman	*Representing*
Shri A. S. Lakshmanan	Senapathy Whiteley Ltd, Bangalore
Members	
Shri B. A. Govindaraj (*Alternate* to Shri A. S. Lakshmanan)	
Shri R. S. Arora	Directorate General of Supplies and Disposals (Inspection Wing), New Delhi
Shri G. R. Bhatia (*Alternate*)	
Dr A. S. Bhaduri	National Test House, Calcutta
Shri S. K. Mukherjee (*Alternate*)	
Shri R. Chakravorty	Universal Petro-Chemicals Ltd, Calcutta
Shri D. P. Chatterji (*Alternate*)	
Shri M. V. Dalal	Bharat Heavy Electricals Ltd, Bhopal
Shri O. P. Chhabra (*Alternate*)	
Shri B. K. Murthy (*Alternate*)	
Shri V. B. Desai	Jyoti Limited, Vadodara
Shri B. G. Sharma (*Alternate*)	
Dr P. Desikan	Nagpal Petro-Chem Ltd, Madras
Shri K. Venkatraman (*Alternate*)	
Dr R. N. Dhar	National Physical Laboratory (CSIR), New Delhi
Director, Central Power Research Institute	Central Electricity Authority, New Delhi
Deputy Director, Central Power Research Institute (*Alternate*)	
Shri K. Doraiswamy	Dr Beck & Co (India) Ltd, Pune
Shri S. B. Bapat (*Alternate*)	
Shri S. N. Gandhi	Permali Wallace Ltd, Bhopal
Shri K. A. Antani (*Alternate*)	
Dr S. R. Gupta	Formica India Ltd, Pune
Dr H. C. Bhasin (*Alternate*)	
Shri P. N. Hiriyannaiah	Kirloskar Electric Co Ltd, Bangalore
Dr B. N. Jayaram (*Alternate*)	
Lt-Col A. P. Jain	Directorate of Standardization (DGI) (Ministry of Defence), New Delhi
Lt-Col V. K. Khanna (*Alternate*)	

(*Continued on page* 2)

© *Copyright* 1977
BUREAU OF INDIAN STANDARDS
This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
Dr M. S. Padbidri	Hindustan Brown Boveri Ltd, Bombay
Shri Y. D. Dosaj (*Alternate*)	
Dr G. M. Phadke	Indian Electrical Manufacturers' Association, Bombay
Shri G. H. Rodricks (*Alternate*)	
Prof G. R. Govinda Raju	Indian Institute of Science, Bangalore
Dr V. Prabhashanker (*Alternate*)	
Shri S. R. Ramachandran	Apar Pvt Ltd, Bombay
Shri S. R. Gupta (*Alternate*)	
Shri C. E. Bhaskar Rao	Bharat Bijlee Ltd, Bombay
Shri S. G. Deshmukh (*Alternate*)	
Shri R. Sen	Hindustan Cables Ltd, Rupnarainpur
Shri Kalyan Ghosh (*Alternate*)	
Shri S. S. Sharma	Jhaveri Thanawala Corporation, Bombay
Shri K. T. Thanawala (*Alternate*)	
Shri A. N. Srivathsa	NGEF Ltd, Bangalore
Shri Aswathnarayana (*Alternate*)	
Dr J. Vaid	Philips India Ltd, Bombay
Dr S. P. Bhide (*Alternate*)	
Shri C. R. Varier	Crompton Greaves Ltd, Bombay
Shri D. H. Pai (*Alternate*)	
Shri V. Venkateswaran	Research, Designs and Standards Organization (Ministry of Railways)
Shri Lallan Prasad (*Alternate*)	
Shri S. P. Sachdev, Director (Elec tech)	Director General, BIS (*Ex-officio Member*)

Secretary

Shri Jagdish Chandra
Assistant Director (Elec tech), BIS

Indian Standard

SPECIFICATION FOR PRESSPAPER FOR ELECTRICAL PURPOSES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 26 August 1977, after the draft finalized by the Electrical Insulations Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard covers requirements of four different types of presspaper used for electrical purposes.

0.3 Details of conditioning the presspaper test pieces are given in Appendix A.

0.4 In preparing this standard assistance has been derived from BS 3255 : 1975 'Specification for presspaper for electrical purposes', issued by the British Standards Institution (BSI).

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers presspaper either dyed or of natural colour of four different types, each up to 0·5 mm thick, supplied either in roll form or as sheets cut from the roll, and with a smooth calendered finish.

NOTE — Presspaper is available in thickness greater than 0·5 mm and with other types of finish (*see* **4.3**). For such presspaper, limits should be the subject of agreement between the purchaser and the manufacturer.

1.2 This standard does not cover:

a) sheet material made on an 'intermittent board' machine which is covered by IS : 1576-1967†, and

b) Straw paper (not considered desirable for electrical purpose).

---

*Rules for rounding off numerical values (*revised*).

†Specification for solid pressboard for electrical purposes.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Presspaper — Multilayer paper made by a continuous process from pulp entirely of natural vegetable origin and of high chemical purity.

2.2 Machine Direction — The direction of the paper corresponding to the flow of the stuff on the machine.

2.3 Cross Direction — The direction of the paper at right angles to the machine direction.

2.4 Perpendicular Direction — The direction at right angles to the surface of the material.

2.5 Central Value — The middle of an odd number of test results or the mean of the two middle values of an even number of test results when these results are arranged in ascending order.

3. CLASSIFICATION

3.1 This specification covers the following four types of presspapers :

Type A — A high density presspaper having good electrical and mechanical properties with a high degree of chemical purity and resistance to ageing;

Type B — A dense presspaper, more absorbent than Type A, and having good resistance to ageing;

Type C — A soft porous presspaper, intended primarily for use in oil, and having a greater oil absorption than Types A and D; and

Type D — A hard presspaper, sometimes referred to as presspahn; usually made from chemical wood pulp.

4. REQUIREMENTS

4.1 Composition — Presspaper of all types covered by this specification shall be made entirely from vegetable fibre, with or without a suitable dye, and shall be free from conducting particles and other extraneous matter.

4.2 Thickness — When determined as described in Appendix B, the thickness of the material at any point shall not differ from the nominal thickness by more than the appropriate value given in Table 1.

4.3 Finish — Presspaper covered by this specification shall have a smooth calendered finish.

NOTE — Presspaper of all types are available with a matt (that is uncalendered), finish and Type D is available also with a glazed finish. When one of these types of finish is required it should be specified at the time of enquiry or order and the limiting values agreed with the supplier.

TABLE 1 PREFERRED THICKNESS AND TOLERANCE ON THICKNESS

(*Clause* 4.2)

PREFERRED NOMINAL THICKNESS* (1) mm	TOLERANCE (2) mm
0·1	±0·01
0·15	+0·02 −0·01
0·20	±0·02
0·25	±0·02
0·30	+0·03 −0·02
0·40	+0·04 −0·03
0·50	±0·04

* For nominal thickness other than the preferred value, the tolerance shall be that given for the next thicker preferred nominal thickness.

4.4 Density — When determined by the method described in Appendix C, the density shall comply with the requirements of Table 2.

TABLE 2 DENSITY

TYPE (1)	MINIMUM (2) kg/m³	MAXIMUM (3) kg/m³
A	1 150	—
B	1 000	1 200
C	900	1 100
D	1 000	—

4.5 Oil Absorption — When determined by the method described in Appendix D, the oil absorption shall be not less than the appropriate value shown in Fig. 1 unless otherwise agreed to between the purchaser and the supplier.

4.6 Breakdown Voltage

4.6.0 *General* — The purchaser and the supplier shall agree whether the test be made in air or oil or both.

4.6.1 *Test in Air* — When tested in accordance with Appendix E, the breakdown voltage shall be not less than the appropriate value given in Fig. 2 and in addition, the results of all five tests shall be greater than 80 percent of the appropriate value given in Fig. 2.

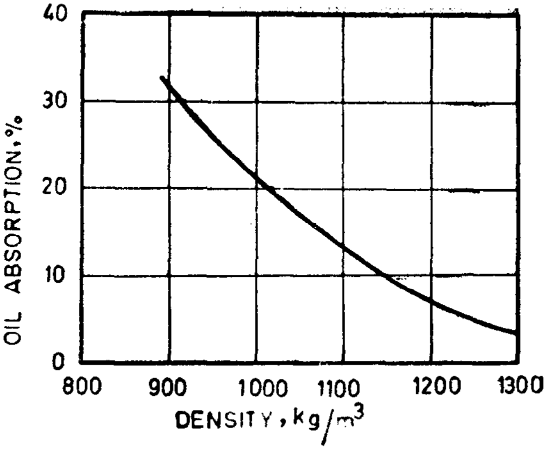


FIG. 1 OIL ABSORPTION AT 105°C

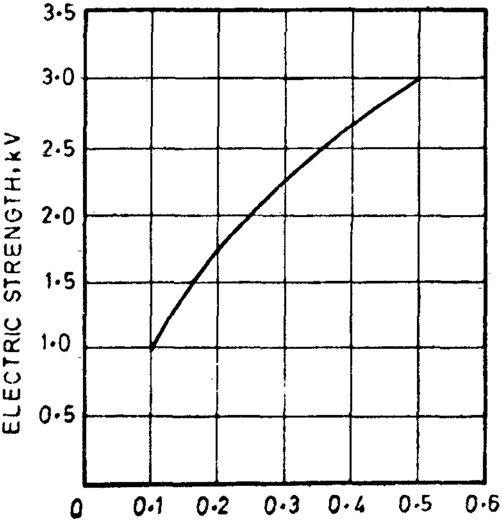


FIG. 2 ELECTRIC STRENGTH AT 90°C IN AIR

4.6.2 *Test in Oil* — When tested in accordance with Appendix E, the breakdown voltage shall be not less than the approximate value given in Fig. 3 and in addition the results of all five tests shall be greater than 80 percent of the appropriate value given in Fig. 3.

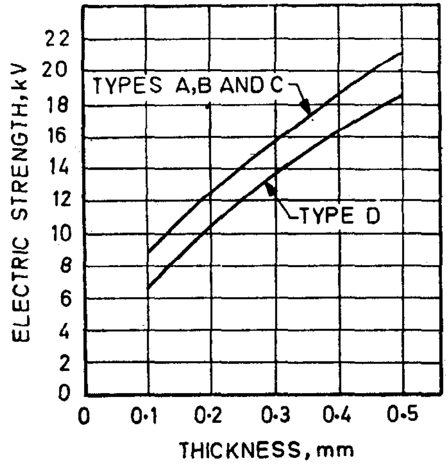


FIG. 3 ELECTRIC STRENGTH AT 90°C IN OIL

4.7 Tensile Strength — When determined by the method described in Appendix F, the tensile strength in either the machine or cross direction of the material shall be not less than the appropriate value given in Fig. 4.

4.8 Ageing in Air — When determined by the method described in Appendix G, the decrease in bursting strength due to heat treatment at 130°C for 168 hours shall not exceed the appropriate value shown in Table 3.

TABLE 3 EFFECT OF AGEING IN AIR

TYPE (1)	MAXIMUM DECREASE IN BURSTING STRENGTH (2)
	Percent
A	35
B	45
C	50
D	60

4.9 Conductivity of Aqueous Extract — When determined by the method described in Appendix H, the conductivity of the aqueous extract shall not exceed the appropriate value given in Table 4.

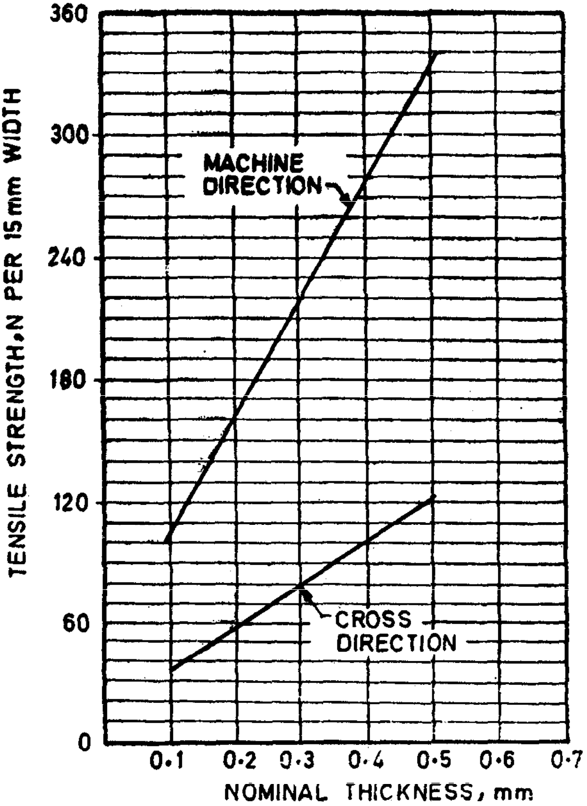


FIG. 4 TENSILE STRENGTH

TABLE 4 CONDUCTIVITY OF AQUEOUS EXTRACT AT 25°C

(*Clause* 4.9)

TYPE (1)	CONDUCTIVITY (2) mS/m
A	1·5
B	2·2
C	2·2
D	3·0

4.10 *p*H Values of Aqueous Extract — When determined by the method described in Appendix J, the *p*H value shall comply with the requirements of Table 5.

TABLE 5 *p*H VALUE

(*Clause* 4.10)

TYPE	MINIMUM	MAXIMUM
(1)	(2)	(3)
A	7·0	9·0
B	6·5	8·5
C	6·0	8·5
D	5·0	8·5

4.11 Moisture Content — When determined by the method described in Appendix K, the amount of moisture in presspaper as received shall not exceed 8 percent.

4.12 Mineral Ash — When determined by the method described in Appendix L, the mineral ash shall not exceed the appropriate value shown in Table 6.

TABLE 6 MINERAL ASH

TYPE	MINERAL ASH
(1)	(2)
	Percent
A	1·0
B	1·5
C	1·5
D	2·0

4.13 Freedom from Conducting Particles — When tested by the method described in Appendix M, presspaper shall be free from conducting particles.

APPENDIX A

(*Clause* 0.3)

CONDITIONING OF TEST PIECES

A-1. CONDITIONING

A-1.1 Condition the test pieces for 18 to 24 hours in a controlled atmosphere of 65 ± 5 percent relative humidity at a temperature of 27 ± 2°C. Arrange the test pieces so as to permit free access of the conditioning atmosphere to all surfaces. Commence the relevant test within three minutes of removal of each test piece from the controlled atmosphere.

A-1.1.1 The atmosphere of 65 percent relative humidity may be obtained conveniently in an enclosed chamber in which a saturated solution of sodium nitrite is exposed to the atmosphere in the chamber. Prepare the saturated solution from distilled water and sodium nitrite of analytical reagent quality.

A-1.2 Expose the saturated solution so that the maximum surface is in contact with the air in the chamber, for example, by covering the floor of the chamber with a tray containing the saturated solution. It is essential to use an ample excess of solid sodium nitrite in contact with the saturated solution. If desired a mobile slurry of salt and saturated solution may be used, this being prepared by adding to the solid salt, of suitable particle size, a previously prepared saturated solution of sodium nitrite until the desired fluid consistency is obtained.

A-1.3 The saturated salt solution or slurry will become contaminated in the course of time; the salt tray should, therefore, be emptied, washed all over, carefully dried and refilled with sufficient saturated solution or slurry at intervals of not more than 2 months. More frequent changes may be necessary if the chamber is used where conditions of severe contamination are experienced.

A-1.4 To ensure uniform conditions throughout the chamber, a fan should circulate air over the surface of the saturated solution or slurry and around the test pieces. From time to time, check that the humidity of the air in the chamber is correct.

NOTE — The method of conditioning given above cannot be applied to presspaper in roll.

APPENDIX B

(*Clause* 4.2)

THICKNESS

B-1. TEST PIECE

B-1.1 If the presspaper is supplied in roll form, remove the three outer layers and then cut a strip about 50 mm long across the full width of the roll.

B-1.1.1 If in sheet form, cut a similar strip in the cross direction if known; if not known, cut the strip across the smaller dimension.

B-2. CONDITIONING

B-2.1 In case of dispute, condition the test piece as described in Appendix A. Where necessary, the strip may be cut into squares for convenience in conditioning.

B-3. TEST TEMPERATURE

B-3.1 Carry out the test at 20^{+15}_{-5} °C

B-4. APPARATUS

B-4.1 Use a micrometer or instrument capable of measuring the thickness of a sheet of presspaper with an instrument error not exceeding 0·005 mm.

B-4.1.1 The apparatus shall have two parallel plane faces between which the paper is placed for measurement. One of the faces shall be movable in a direction perpendicular to the other, which is fixed. The movable face or pressure foot shall be circular with an area of 161 ± 8 mm^2 corresponding to a diameter of 14·3 ± 0·3 mm. The fixed face or anvil shall also be circular, the area being equal to or greater than the area of the pressure foot. The faces shall be concentric and parallel to within 0·002 5 mm over the whole range of travel. The pressure foot shall exert a steady pressure of 52 + 4 kN/m^2. To ensure that the pressure is uniform within the limits given the use of a deadweight rather than a spring is preferred.

B-4.1.2 Alternatively, a screw micrometer fitted with a ratchet and complying with IS : 2967-1964* is satisfactory for the measurement of thickness of presspaper when used by an operator accustomed to make such measurements. The diameter of each anvil of the screw micrometer should be not less than 9·5 mm, and not more than 12·7 mm. In tightening up the micrometer, the ratchet should be employed. Before the thickness of the presspaper is measured, the micrometer should be closed on the presspaper at a place outside the area to be measured. The micrometer should then be opened not more than 0·15 mm, and then moved into the area selected for measurement. The micrometer spindle should be closed on the presspaper at the rate of about 0·05 mm/s. The closing motion should be continued at the same rate until the ratchet has clicked three times, and then the reading of the micrometer should be taken.

B-5. PROCEDURE

B-5.1 Make ten measurements to the nearest 0·01 mm across the strip or in corresponding positions on the portions cut from it. In making these measurements, lower the pressure foot gently so that any punching effect is avoided and refrain from placing stress on the instrument or test piece by hand when readings are being taken.

---

*Specification for external micrometer.

B-6. REPORT

B-6.1 Report the ten measurements aud indicate any, which are outside the acceptable limit. Record the central value for use as the thickness in other tests on samples taken from the same roll or sheet.

APPENDIX C

(*Clause* 4.4)

DENSITY

C-1. PROCEDURE

C-1.1 Dry a test piece approximately 75 mm square in a ventilated oven at a temperature of 105 ± 2°C for 6 to 18 hours. Allow it to cool in a desiccator, and then immediately weigh it to the nearest milligram. Compute the area of the test piece from the mean of four measurements (made to an accuracy of at least 0·5 mm) of the length and width at points equally spaced along each of the two edges at right angles. Determine the thickness by making four measuremnts with a micrometer complying with IS : 2967-1964* at points equally spaced around the sides, and take the mean value in computing the volume of the test piece. Express density in kg/m^3.

APPENDIX D

(*Clause* 4.5)

OIL ABSORPTION

D-1. PROCEDURE

D-1.1 After the density of the test piece has been determined as in Appendix C, immerse it immediately in insulating oil, complying with IS : 335-1972† at a temperature of 105 ± 2°C for 24 hours. Remove the test piece from the oil, remove surplus oil by means of blotting-paper and after cooling in a desiccator again weigh to the nearest milligram. Compute the percentage absorption of the oil on the mass of the dry test piece before immersion in oil.

---

*Specification for external micrometers.

†Specification for new insulating oils for transformers and switchgear (*second revision*).

APPENDIX E

(*Clause* 4.6)

BREAKDOWN VOLTAGE

E-1. TEST PIECES

E-1.1 Five test pieces, each approximately but not less than, 100 mm^2, are required for each determination (namely, five tests in air and five tests in oil), but two or three more may be necessary for preliminary tests. Use a sample of presspaper of which the thickness is known (as determined in Appendix B).

E-2. CONDITIONING FOR TEST IN AIR

E-2.1 Before the breakdown voltage tests are carried out in air, dry the test pieces in an oven at 105 ± 2°C for 6 to 18 hours. Then reduce the temperature of the oven to 90 ± 2°C and without removing the test pieces from the oven, place the electrodes, previously heated to 90 ± 2°C in position for the test.

E-3. CONDITIONING FOR TEST IN OIL

E-3.1 Before the breakdown voltage tests are carried out in oil, dry the test pieces in an oven at 105 ± 2°C for 6 to 18 hours and then immerse them in insulating oil at a temperature of 90 ± 2°C for 24 hours. The oil should comply with the requirements of IS : 335-1972*.

E-3.1.1 For each test, place a test piece symmetrically between the electrodes previously heated to 90 ± 2°C and immerse the whole in the oil. Maintain the oil at a temperature of 90 ± 2°C for not less than 15 minutes before applying the voltage.

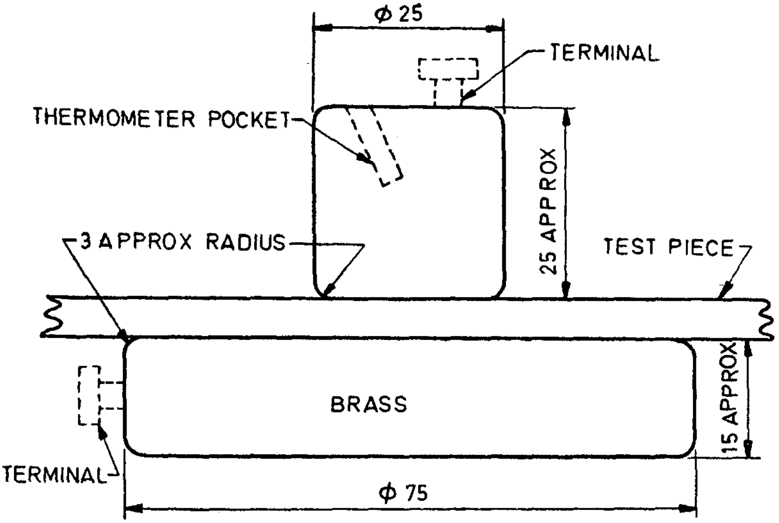
E-4. ELECTRODES

E-4.1 The lower electrode shall be a solid cylinder of brass 75 mm in diameter and approximately 15 mm high. The upper electrode shall consist of a solid cylinder of brass 25 mm in diameter and approximately 25 mm high (*see* Fig. 5). The faces which will be in contact with the test sample shall be smooth and plane and their edges shall have a radius of 3 mm. The top electrode shall be pressed on to the test piece with a load of 10 kg.

E-4.1.1 Provision shall be made for positioning the electrodes in oven or oil chamber for the test so that the contacting faces are concentric and horizontal.

---

*Specification for new insulating oils for transformers and switchgear (*second revision*).



All dimensions in millimetres.

FIG. 5 ELECTRODE ARRANGEMENT FOR ELECTRIC STRENGTH TEST

E-5. TEST VOLTAGE

E-5.1 The test voltage shall be alternating and of a frequency in the range 48 to 62 Hz. It shall be of approximately sine-wave form; the ratio of the peak value to the rms value shall lie within the limits of 1·34 to 1·49, that is $\sqrt{2} \pm 5$ percent.

E-5.1.1 The test voltage should be expressed as its peak value divided by $\sqrt{2}$. It shall be determined by means of peak or other type of voltmeter connected across the output winding of the transformer. Alternatively, it may be measured by means of a voltmeter connected across the input winding, or across a portion of the output winding, or across a special voltage winding. Any instrument used, should be calibrated against a sphere-gap but calibration of an rms instrument against a peak voltmeter shall be permissible if there is evidence, such as a certificate of calibration, that the peak voltmeter is free from error. If there is any risk of the current taken by the test piece altering the no-load calibration appreciably, the calibration against the sphere-gap should be made with the test piece in circuit.

E-6. PROCEDURE FOR TEST IN AIR AND IN OIL

E-6.1 Raise the voltage from zero at a uniform rate such that breakdown occurs on an average between 10 and 20 seconds. This procedure requires some previous knowledge of the characteristics of the material. Otherwise, one or two preliminary tests are needed. It is considered satisfactory if the average time to breakdown lies within the above limits, even though one or two times are outside.

E-7. RESULT

E-7.1 The breakdown voltage is the central value of the five test results expressed in kV but all results need to be examined for compliance with **4.6**.

APPENDIX F

(*Clause* 4.7)

TENSILE STRENGTH

F-1. TEST SPECIMENS

F-1.1 If the material is supplied in rolls, discard the three outer layers. Each test specimen is a strip of uniform width of 15·0 ± 0·1 mm. The minimum length should be 250 mm but instrument jaw design may require the preparation of longer test specimens.

F-1.1.1 The centre 180 mm of the test specimen should he handled as little as possible before testing.

F-1.1.2 The test specimens shall not include any part of the sample within 25 mm of the edge of any sheet or roll.

F-1.2 Two sets of five specimens each (plus spares in case of faulty breaks) are required, one set in the machine direction and other in the cross direction, both sets being suitably spaced out across the width of the presspaper. If the machine direction is not known one set shall be cut with the strip length parallel to one side and the other set at right angles. The set giving the greater value of tensile strength shall be deemed to have been cut in the machine direction.

F-2. CONDITIONING

F-2.1 Condition the test specimens as described in Appendix A.

F-3. APPARATUS

F-3.1 Any system may be used which is capable of acting on the test specimen at the defined rate and of permitting the tensile force at the moment of failure to be read to an accuracy of 1 percent.

F-3.2 The rate of loading shall be so adjustable that failure of the test specimen may be obtained in a mean time of 20 ± 10 seconds.

F-3.3 The centre line of the clamps and of the test specimen shall lie along the same axis, which shall also be parallel to the direction of the applied stress. The clamping surface of the two clamps (flat clamps) or lines of contact (line contact clamps) shall be in the same plane and so aligned that they hold the test piece in that plane throughout the test.

F-3.4 The clamps shall grip the test specimen firmly along its full width, without slippage, throughout the test.

F-3.5 At the start of the test the lines of contact (if line contact clamps are used) or the inner edges of the contact areas shall be 180 mm ± 2 mm apart and shall be perpendicular to the centre line of the test specimen.

F-4. PROCEDURE

F-4.1 Measure the width of each test specimen to the nearest 0·5 mm inside, or immediately after removal from the conditioning atmosphere and make the test either in the conditioning atmosphere or immediately on removal from it and at a temperature of 20^{+15}_{-5} °C

F-4.2 Select a rate of application of tensile force to cause failure in a mean time of 20 ± 10 seconds.

F-4.3 The test specimens shall be clamped within the jaws of the apparatus so that no slippage occurs during the test. Tests which result in failure within 10 mm of the line of contact, or the inner edge of the contact area of the clamps shall be ignored, and fresh specimens tested.

F-4.4 Record the breaking force to the nearest 0·5 N and the ‘ time to break ’.

F-5. RESULTS

F-5.1 State the widths and nominal thickness of the test specimens and compute the results in N/15 mm width. The central values of the results of the five tests in machine and cross directions are the tensile strength in these directions respectively.

APPENDIX G

(*Clause* 4.8)

AGEING IN AIR

G-1. PRINCIPLE OF TEST

G-1.1 Bursting strength tests are made on the presspaper after conditioning, and again on adjoining areas after subjection to a heat treatment and reconditioning.

G-2. TEST PIECES

G-2.1 Cut five test pieces each of a size to allow four tests on the bursting machine.

G-3. AGEING PROCEDURE

G-3.1 Condition the test pieces in accordance with Appendix A and make two bursting strength determination on each of five test pieces, inside or immediately after removal from the controlled atmosphere. Care should be taken to ensure that sufficient space is left on each piece for further two tests to be carried out after the heat treatment.

G-3.2 Suspend the test pieces in an oven similar to that described in Appendix N at a temperature of 130 ± 2°C. Care should be taken to prevent exposure of the test pieces to direct radiation from the heaters and to ensure that the test pieces are spaced at least 25 mm apart and not less than 50 mm from the sides, top and bottom of the inner casing (or baffles).

G-3.3 After exposure for 168 hours, remove the test pieces from the oven and condition in accordance with Appendix A. Determine the bursting strength as in **G-3.1** but on the other half of each test piece.

G-4. APPARATUS

G-4.1 Use a hydraulically operated machine of 'Mullen' type so mounted on a horizontal base as to be free from external vibrations.

G-5. BURSTING STRENGTH TEST PROCEDURE

G-5.1 Raise the clamp and insert the test piece in a position enabling the full clamping area to be utilized; then apply the clamp firmly to the test piece. The clamping pressure should be firm enough to prevent slipping, but not so heavy that the presspaper is damaged. Such damage causes the burst to occur around the periphery of the test area. Slippage may be detected by the presence of creases after bursting or by slight movement of presspaper around the outside of the clamp during the test; it may be due to either insufficient clamping pressure or to non-uniform clamping pressure if the clamp faces are not parallel. Readings should be rejected when slippage has occurred.

G-5.2 Apply the hydraulic pressure at the correct rate; on a motor-driven tester by engaging the mechanism; on a manually operated instrument by turning the handle at the appropriate speed to give a pumping rate of 35 ± 5 ml/min.

G-5.3 Immediately the presspaper has burst, the piston should be fully retracted and the clamp released. The pressure indicated on the gauge should then be read to the nearest 1 kN/m^2 and the maximum pointer returned to near zero for the next test. The test result should be between 15 percent and 85 percent of the scale range of the gauge used.

G-6. RESULTS

G-6.1 Record the central value of each set of ten results as the bursting strength of that set. Report the bursting strength of the presspaper before and after heat ageing. Express the decrease in bursting strength as a percentage of the bursting strength before ageing.

APPENDIX H

(*Clause* 4.9)

CONDUCTIVITY OF AQUEOUS EXTRACT

H-1. PRECAUTIONS

H-1.1 Take care that samples for this test are not contaminated by atmosphere, particularly the atmosphere of a chemical laboratory during storage.

The implements used for cutting or handling the material shall be chemically clean.

H-2. PREPARATION OF EXTRACT

H-2.1 Use distilled water with a conductivity not greater than 200 μS/m.

H-2.2 Make a blank test before each extraction and if the resultant conductivity exceeds 200 μS/m, repeat the test with the same extraction vessel. Discard the vessel if the second result also exceeds 200 μS/m.

H-2.3 Prepare the extract by cutting the presspaper into strips approximately 20 × 3 mm. Put a mass of presspaper in the ratio of 1 g of the strips to 100 ml of distilled water into a round-bottommed borosilicate glass (high grade resistant glass) or quartz flask, fitted with a reflex condenser of either the same quality glass or quartz. Use apparatus with interchangeable conical ground glass joints. While preparing the samples, the presspaper should be taken and its edges in the longitudinal direction should be trimmed at least up to 2 mm on both sides to remove dust and other particles likely to stick to the edges during handling and transportation.

H-2.4 Boil the water gently for 10 minutes taking care that the presspaper is not charged, then allow it to cool as rapidly as possible using a carbon dioxide trap fitted to the condenser for preventing the admission of carbon dioxide.

H-3. APPARATUS

H-3.1 A suitable conductivity cell is required, in conjunction with a bridge circuit supplied with current at a frequency in the range of 50 to 3 000 Hz.

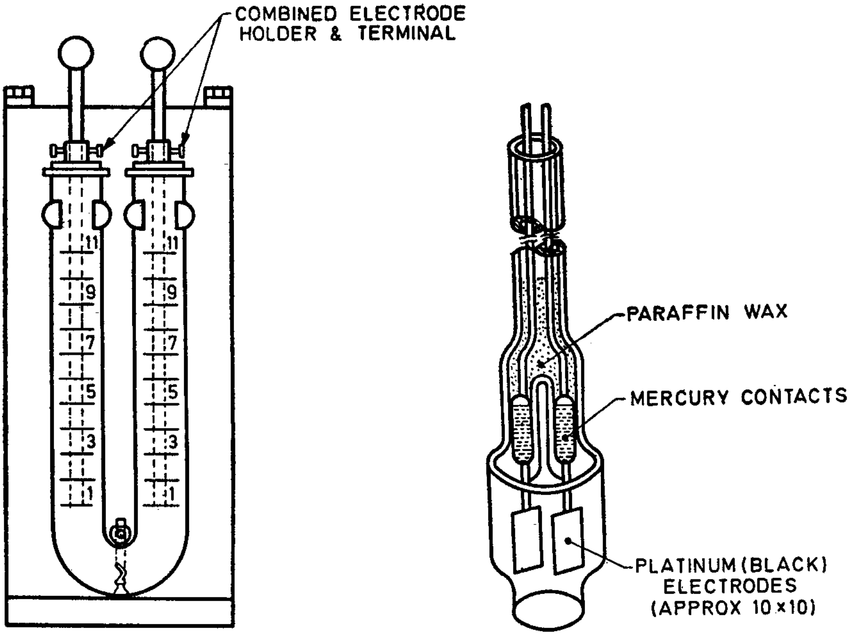
H-3.2 A suitable cell consists of two electrodes of inert metal, for example, platinum, maintained at a fixed distance apart and adequately insulated from each other. In one type (immersion cell) the electrodes are almost enclosed in a glass shield which protects the electrodes and limits the fringing current but allows full access of the test liquid to the electrodes during immersion (Fig. 6A). In a second type of cell (Fig. 6B) the extract is contained in a special glass vessel the sides of which nearly touch the edges of the electrodes when the cell is assembled. It is important that any insulation which is immersed in the test liquid should not be water absorbent or subject to contamination by aqueous electrolytes. The cell should be easy to clean and free from recesses where impurities may be retained.

H-3.3 The cell constant should preferably be within the range of 5 m^{-1} to 50 m^{-1}.

H-4. METHOD OF MEASUREMENT

H-4.1 Determination of Cell Constant — Determine the cell K, if not known, by means of a solution of known specific conductivity containing 0·074 6 g of dry potassium chloride (AR Grade) in 1 000 ml of low conductivity water at a temperature of 20°C. Rinse the cell thoroughly with the solution and then fill. Maintain the temperature at 27 ± 1°C for 15 minutes and then measure the resistance R in MΩ at that temperature.

H-4.1.1 Make a measurement at a temperature of 27 ± 1°C of the resistance R_0, in MΩ, of the cell filled with the water used for the preparation of the potassium chloride solution, the cell having been thoroughly rinsed out with this water before filling.


COMBINED ELECTRODE HOLDER & TERMINAL
11
9
7
5
3
1
11
9
7
5
3
1
PARAFFIN WAX
MERCURY CONTACTS
PLATINUM (BLACK) ELECTRODES (APPROX 10×10)

6A

6B

FIG. 6 CELLS FOR DETERMINATION OF CONDUCTIVITY OF AQUEOUS EXTRACT

H-4.1.2 The cell constant K is then calculated as follows:

$$K = \frac{14\,740\,R}{1 - \dfrac{R}{R_0}}$$

H-4.2 Determination of Conductivity of Blank —After thoroughly cleaning the cell with low conductivity water, fill the cell with the water obtained as a result of the blank extraction test and measure its resistance R_1 in megohms at 27 ± 1°C. The conductivity of the blank in μS/m is then given by K/R_1.

H-4.3 Determination of Conductivity of Water Extract — Thoroughly rinse the cell with the extract to be tested and then fill with the extract. Adjust the temperature of 27 ± 1°C, maintain at that value for 15 minutes, and then measure the resistance R_2 in MΩ at that temperature.

H-4.3.1 The conductivity of the water extract in μS/m is then calculated as K/R_2 — (conductivity of the blank determined in **H-4.2**).

H-4.3.2 Where it is not convenient to test the water extract at 27 ± 1°C it is sufficiently accurate to apply the following correction:

$$\text{Conductivity at } 27^\circ\text{C} = \frac{G}{1 + 0{\cdot}02\,(t - 25)}$$

where

G is the conductivity obtained when the measurement is made at t °C.

APPENDIX J

(*Clause* 4.10)

*p*H VALUE OF AQUEOUS EXTRACT

J-1. PRECAUTIONS

J-1.1 Take care that samples for this test are not contaminated by atmosphere, particularly the atmosphere of a chemical laboratory during storage.

J-2. EXTRACTION

J-2.1 Prepare the aqueous extract of the presspaper by the method described in Appendix H.

J-3. *p*H DETERMINATION

J-3.1 Determine the *p*H value by an electrometric method at a temperature of 15 to 25°C as soon as possible after the preparation of the extract.

APPENDIX K

(*Clause* 4.11)

MOISTURE CONTENT

K-1. PROCEDURE

K-1.1 Without conditioning, weigh a test piece of approximately 75 mm^2. Dry the test piece at a temperature of 105 ± 2°C until it reaches a constant mass. Calculate the loss in mass, namely the moisture content, as a percentage of the original mass of the test piece.

APPENDIX L

(*Clause* 4.12)

MINERAL ASH

L-1. PROCEDURE

L-1.1 Dry 2 to 5 g of presspaper at a temperature of 105°C for 3 hours and then weigh it to an accuracy of 0·01 g to obtain the dry mass.

L-1.2 Ignite the test portion to constant mass at a temperature of 900 ± 25°C taking all precuations against loss, care being taken to ensure the absence of unburnt carbon in the ash. Weigh the residue of incombustible matter (ash) to the nearest milligram and compute the amount as a percentage on the mass of the test portion.

NOTE — Make two determinations of the ash content. The higher of the two results is the mineral ash but if the results do not agree to within 10 percent of the mean, discard the results and repeat the tests.

APPENDIX M

(*Clause* 4.13)

FREEDOM FROM CONDUCTING PARTICLES

M-1. PRINCIPLE OF TEST

M-1.1 The material is passed between electrodes to one of which is applied an alternating voltage considerably lower than that corresponding to the electric strength of the material.

M-1.1.1 A recording instrument or other suitable arrangement indicates failure of the insulation of the presspaper.

M-2. TEST PIECE

M-2.1 The usual form is a strip not less than 300 mm wide but dimensions are not important provided an area of approximately 1 m^2 is tested.

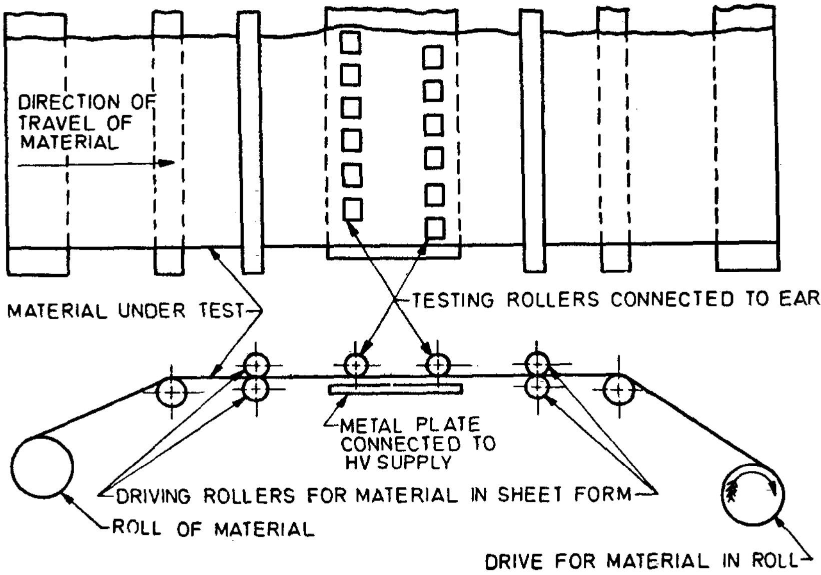
M-2.2 It is unnecessary to condition the test piece unless it is known or suspected to have been exposed to damp conditions.

M-3. TEST TEMPERATURE

M-3.1 Carry out the test at 20^{+15}_{-5} °C.

M-4. APPARATUS

M-4.1 This is as shown diagrammatically in Fig. 7. It consists basically of a flat plate electrode and a set of overlapping brass rollers each approximately 25 mm long and 22 mm in diameter with rounded edges.


DIRECTION OF TRAVEL OF MATERIAL
MATERIAL UNDER TEST
TESTING ROLLERS CONNECTED TO EARTH
METAL PLATE CONNECTED TO HV SUPPLY
DRIVING ROLLERS FOR MATERIAL IN SHEET FORM
ROLL OF MATERIAL
DRIVE FOR MATERIAL IN ROLL

All dimensions in millimetres.

FIG. 7 DIAGRAMMATIC ARRANGEMENT OF APPARATUS FOR TEST FOR CONDUCTING PARTICLES

M-4.2 A lamp or other suitable indicator is connected across the electrodes so as to indicate current conduction through the presspaper.

M-4.3 A suitable resistance in the testing circuit prevents damage to the electrodes when failure occurs.

M-5. PROCEDURE

M-5.1 The test piece is passed smoothly at a speed of approximately 6 m/min between the electrodes between which is applied an alternating voltage with a frequency of 48 to 62 Hz equivalent to 2 kV (rms) per mm of nominal thickness.

M-6. REPORT

M-6.1 Report if no failure occurs or otherwise the number of failures per square metre.

APPENDIX N

(*Clause* G-3.2)

OVEN SUITABLE FOR AGEING TEST

N-1. DESCRIPTION

N-1.1 The internal dimensions of the oven should be not less than 300 × 300 × 450 mm. It should be double walled; the space between the two walls should be not less than 50 mm and lagged with suitable heat insulation. The oven should be installed in a position which is relatively free from draughts. The inner wall of the oven should be of copper. The front should be fitted with a hinged door either with or without an inspection window for reading the thermometer which passes through a central hole in the top of the oven. If a window is not provided, a thermometer not less than 450 mm long should be used which is graduated from 80°C to 160°C over the upper 150 mm.

N-1.2 Electric heating units should be placed at the bottom and two sides, preferably located between the two walls of the oven. It is also desirable to install heaters in the back and the door. If the heating units are placed inside the oven they should be screened by baffles to prevent direct radiant heat impinging on the specimens. The heaters should be controlled by switches and thermostats in such a manner that when steady conditions are reached, a temperature of 130°C may be maintained in the working space of the oven for an indefinite period with a variation not exceeding 2°C.

N-1.3 Experience has shown that it is best to arrange the heaters in such a manner that the majority of heaters are on permanently, whilst one or two are operated thermostatically; by this means close temperature control may be maintained. Also, by this arrangement the value of the current which has to be switched on and off by the contactor is reduced.

N-1.4 It has been found convenient to obtain the required stability of temperature by placing a second thermostat inside the oven near the back extending to about one-third of the distance from the top, and connected in series with the first thermostat at the bottom of the oven, but set to operate at about 1°C above it. By this means, should the ambient temperature drop and tend to cause the lower thermostat to remain on longer, the upper thermostat will break the circuit as soon as the temperature at the top of the oven increases by 1°C.

N-1.5 The air in the oven should be changed not less than ten times per hour (measured by anemometer). A certificate should be supplied with the oven, stating the number of times per hour the air in the oven is completely changed when steady conditions are reached, at the specified temperature of 130°C.